

Monitor and Improve the GOES Imager Infrared Calibration Accuracy: An Application of GSICS

Fangfang Yu¹, Xiangqian “Fred” Wu² and Mitch Goldberg²

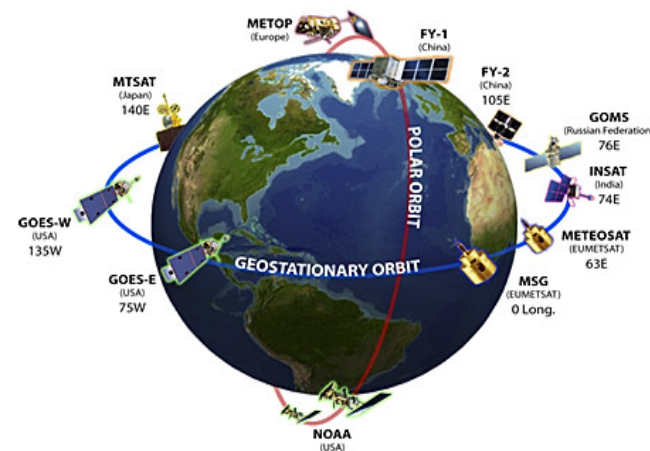
1: ERT, Inc @ NOAA/NESDIS/STAR

2: NOAA/NESDIS/STAR

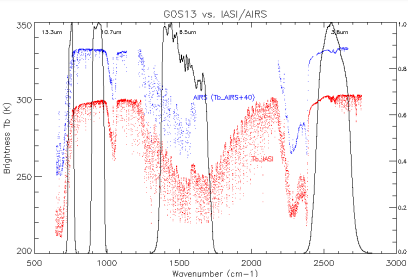
11 November 2011

GSICS GEO-LEO Inter-Calibration

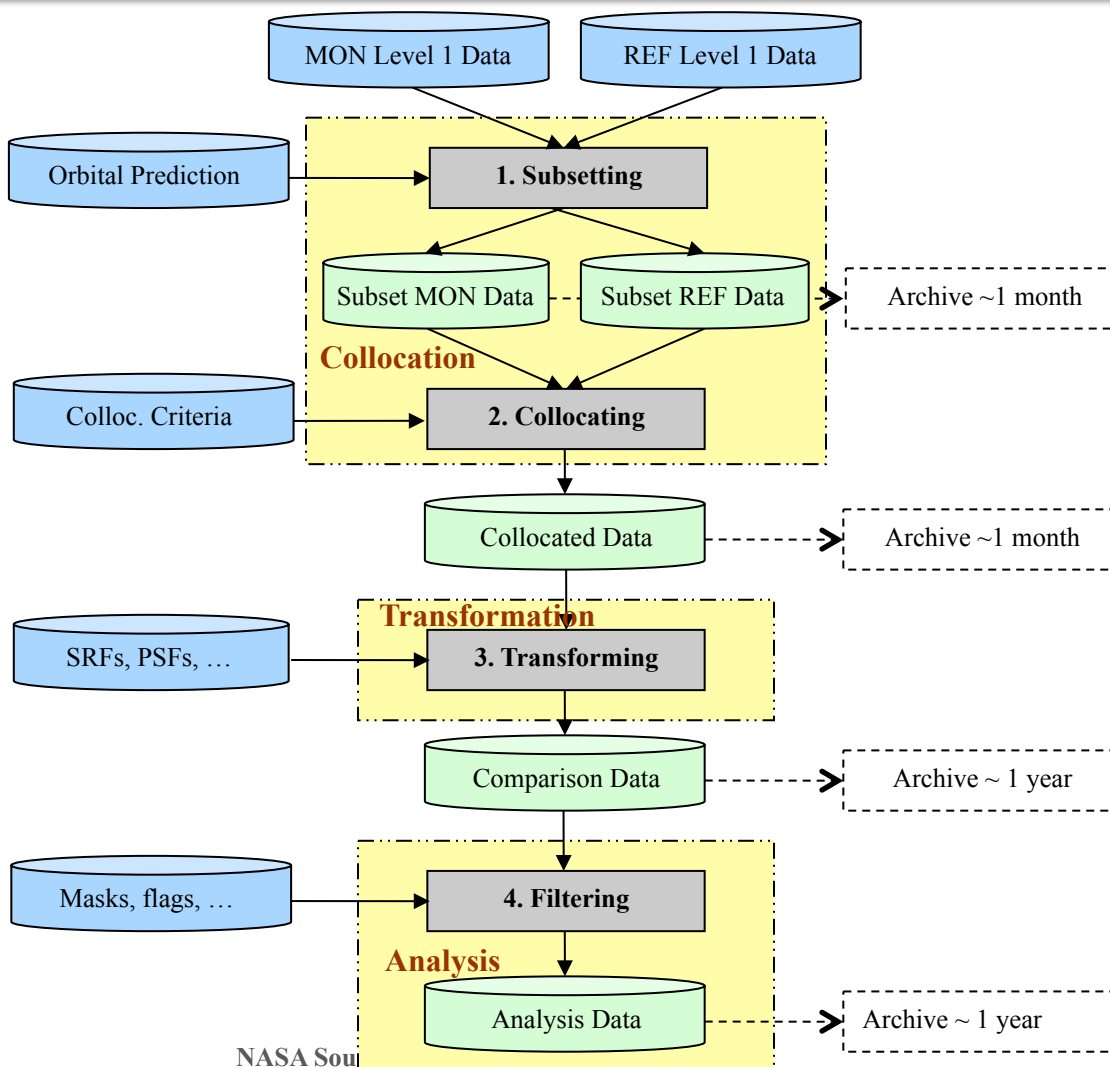
- *Global Space-based Inter-Calibration System (GSICS)*
 - » International collaboration to improve and harmonize the operational satellite calibration accuracy through a variety of inter-calibrations
 - » GEO-LEO inter-calibration to improve the GEO IR calibration accuracy
- *GEO-LEO Inter-calibration*
 - » Reference instruments: AIRS and IASI
 - » Both radiometers are very stable
 - Negligible diurnal and seasonal calibration variation
 - Long-term stable since in-orbit
 - High spectral calibration accuracy
 - Very small difference radiometric between AIRS and IASI



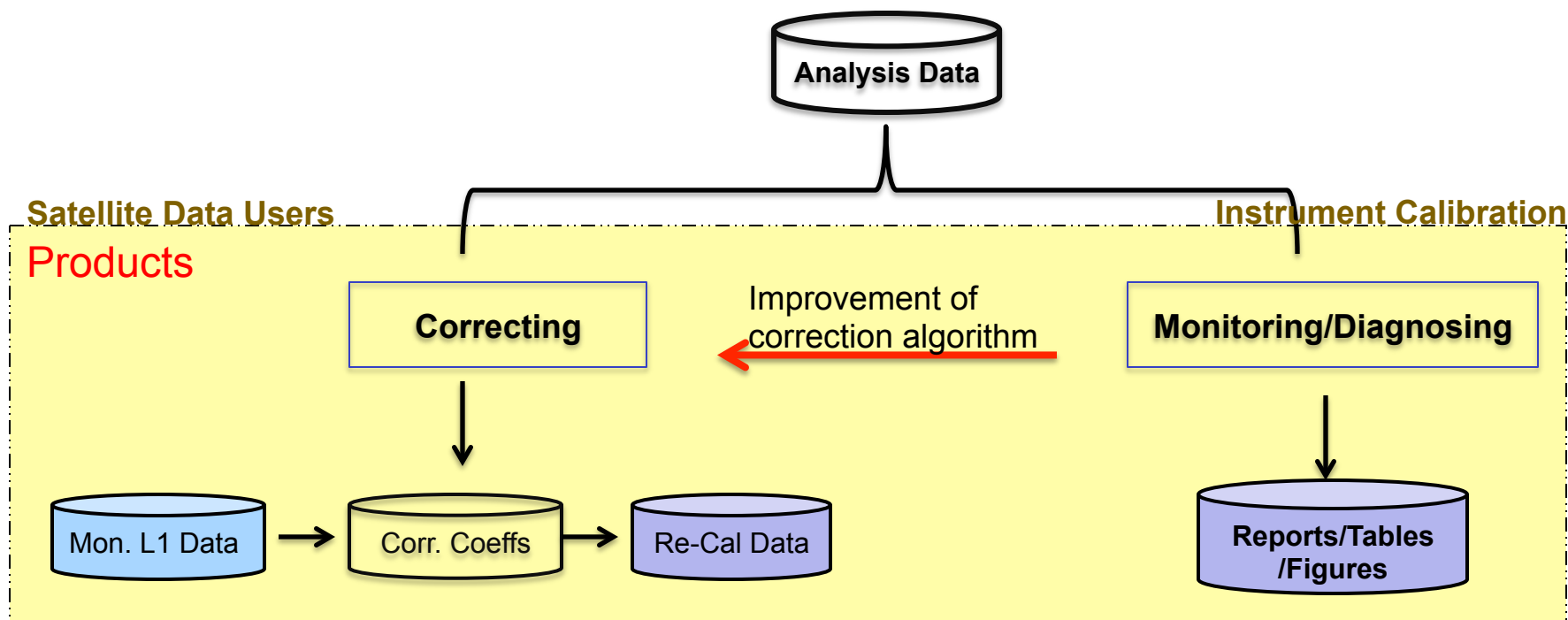
Data Processing Flowchart



- Spatial collocation
- Temporal collocation
- Viewing geometry alignment



Data Analysis

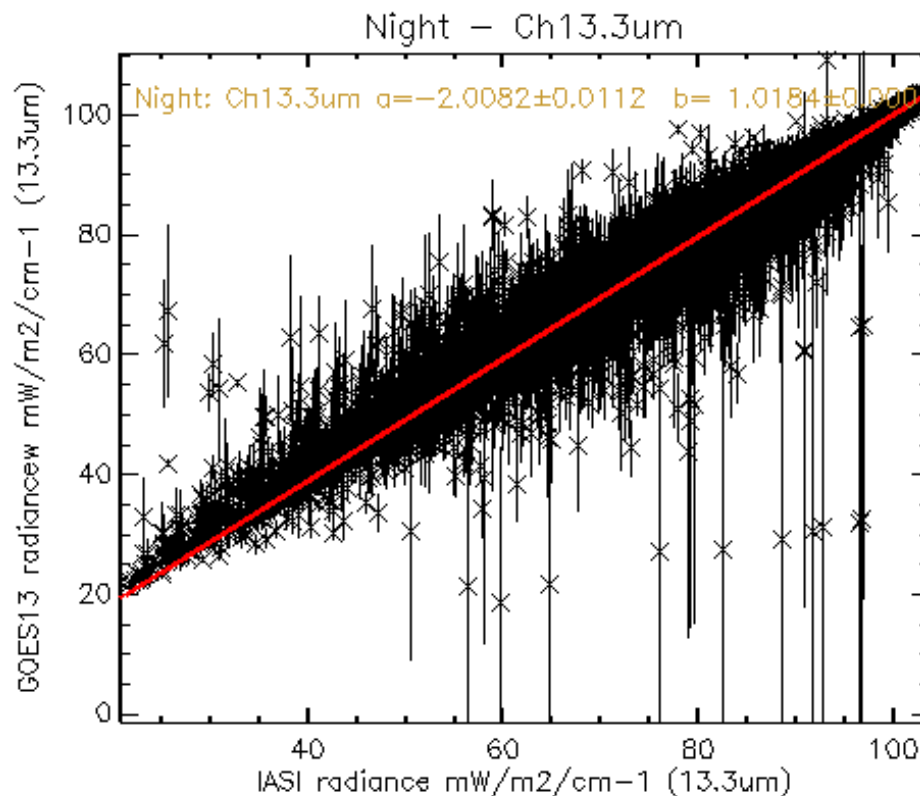


GSICS GEO-LEO inter-calibration correction is traceable to IASI standard

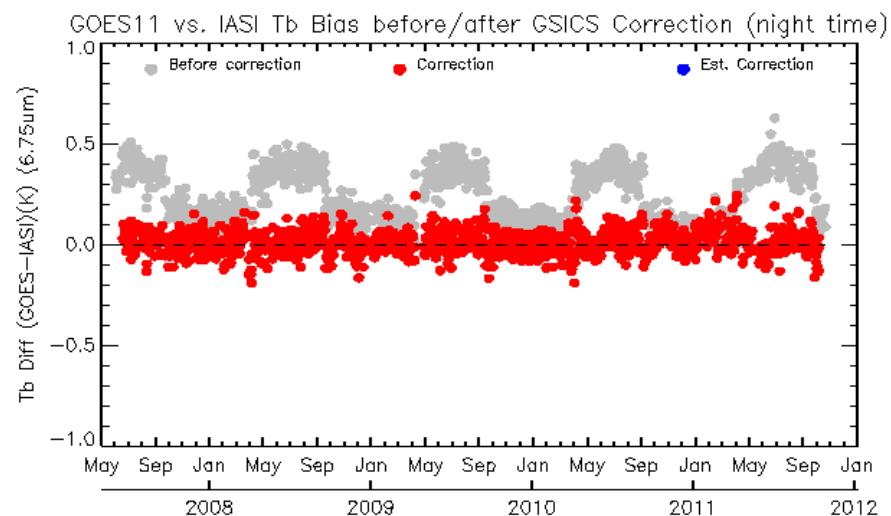
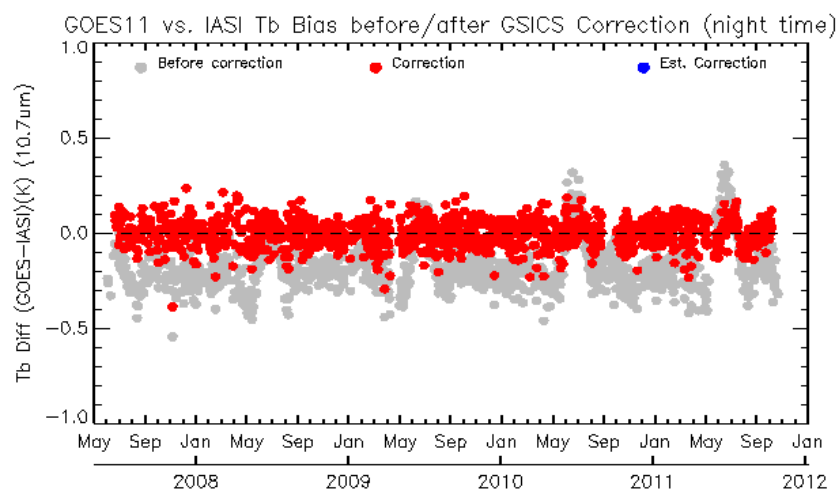
GSICS GEO-LEO Correction Algorithm

$$I_{GEO} = a + b * I_{LEO}$$

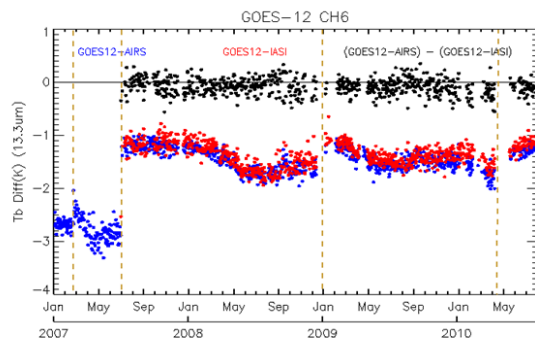
$$I_{Correct} = -\frac{a}{b} + \frac{1}{b} I_{GEO}$$



GSICS Correction Result (1)

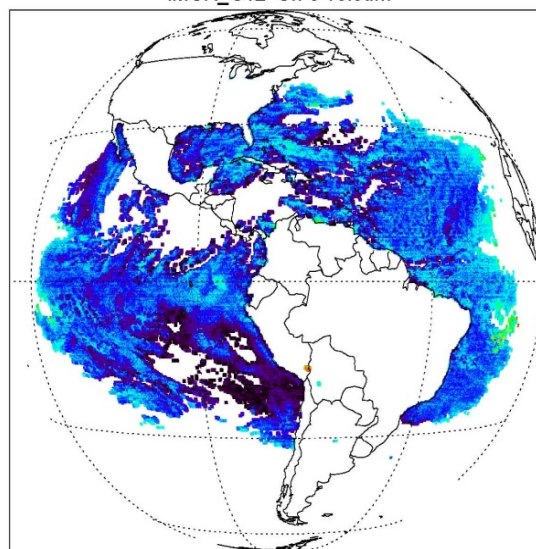


GSICS Correction Result (2)

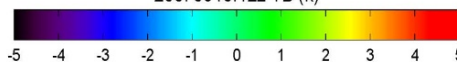


Before Correction: 3K Bias

IMGR_G12 Ch-6 13.3um

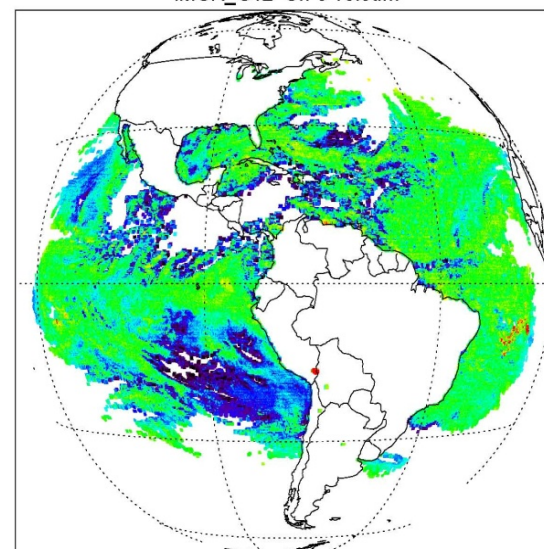


20070610.12z TB (k)

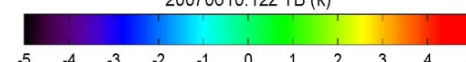


After Correction: ~0K Bias

IMGR_G12 Ch-6 13.3um



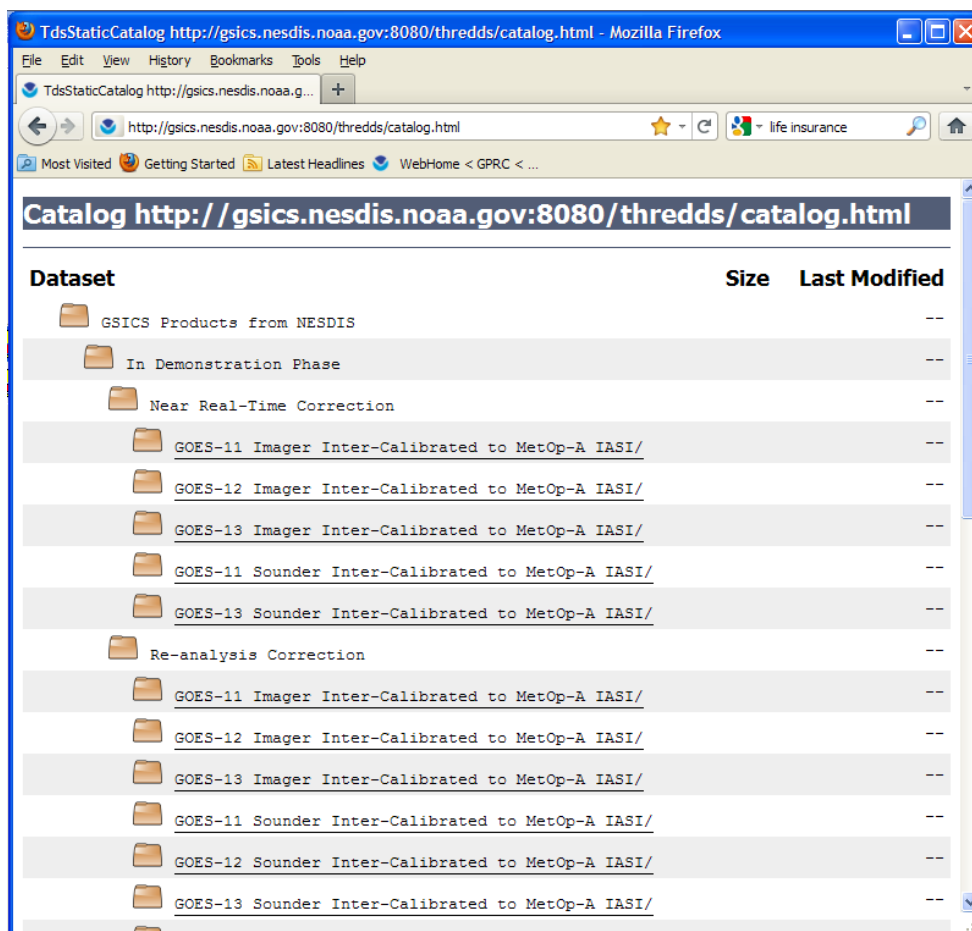
20070610.12z TB (k)



Tb difference between observed and calculated for GOES-12 Ch6 (13.3um) before and after the GSICS correction

GSICS Correction Coeffs.

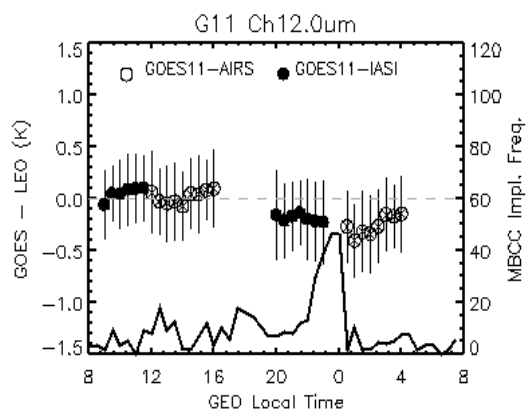
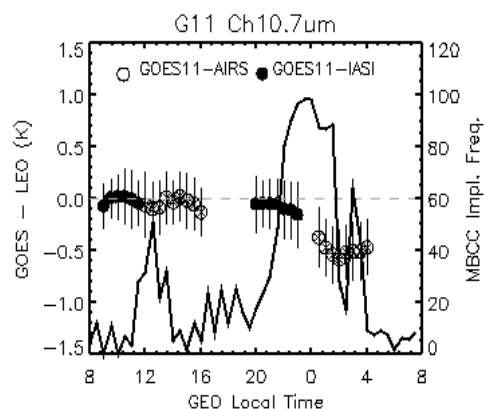
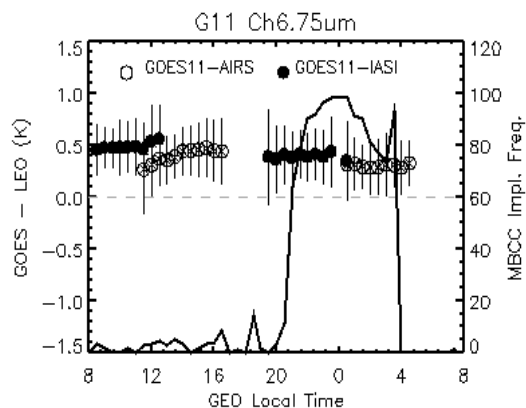
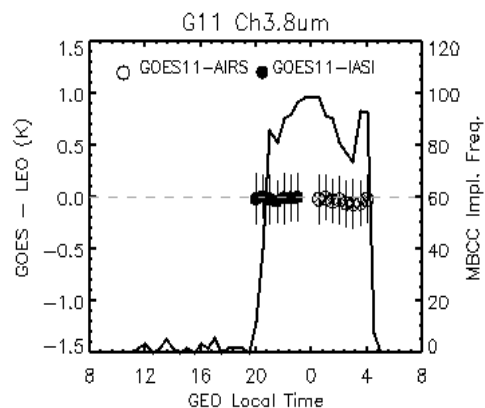
- <http://gsics.nesdis.noaa.gov:8080/thredds/catalog.html>



Dataset **Size** **Last Modified**

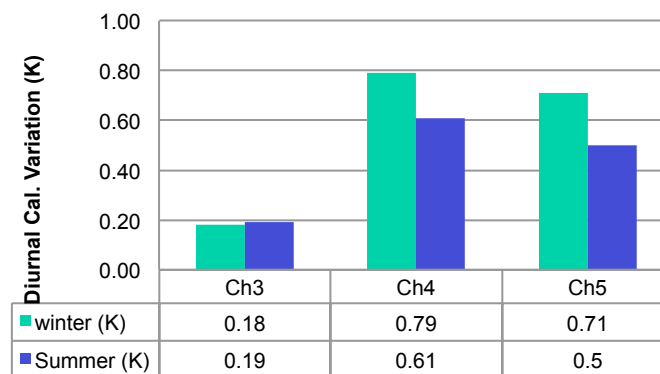
- GSICS Products from NESDIS --
- In Demonstration Phase --
 - Near Real-Time Correction --
 - GOES-11 Imager Inter-Calibrated to MetOp-A IASI/ --
 - GOES-12 Imager Inter-Calibrated to MetOp-A IASI/ --
 - GOES-13 Imager Inter-Calibrated to MetOp-A IASI/ --
 - GOES-11 Sounder Inter-Calibrated to MetOp-A IASI/ --
 - GOES-13 Sounder Inter-Calibrated to MetOp-A IASI/ --
 - Re-analysis Correction --
 - GOES-11 Imager Inter-Calibrated to MetOp-A IASI/ --
 - GOES-12 Imager Inter-Calibrated to MetOp-A IASI/ --
 - GOES-13 Imager Inter-Calibrated to MetOp-A IASI/ --
 - GOES-11 Sounder Inter-Calibrated to MetOp-A IASI/ --
 - GOES-12 Sounder Inter-Calibrated to MetOp-A IASI/ --
 - GOES-13 Sounder Inter-Calibrated to MetOp-A IASI/ --

GOES Diurnal Calibration Variation

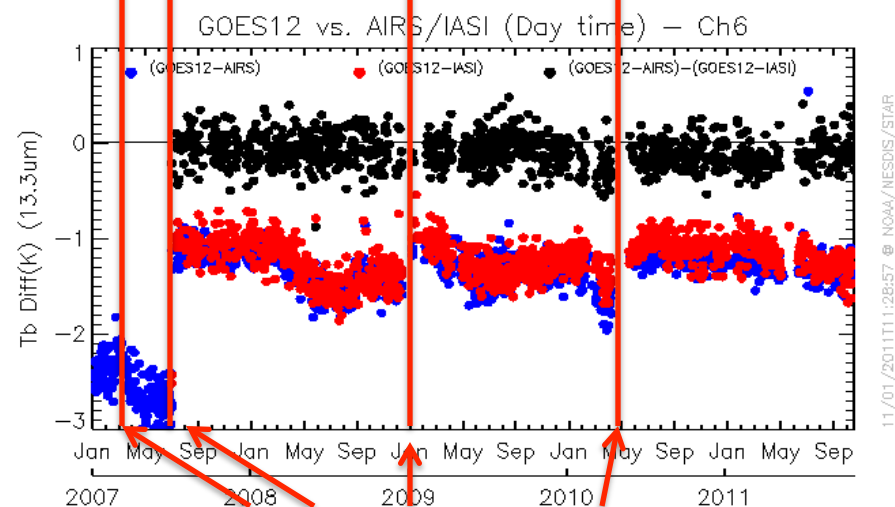
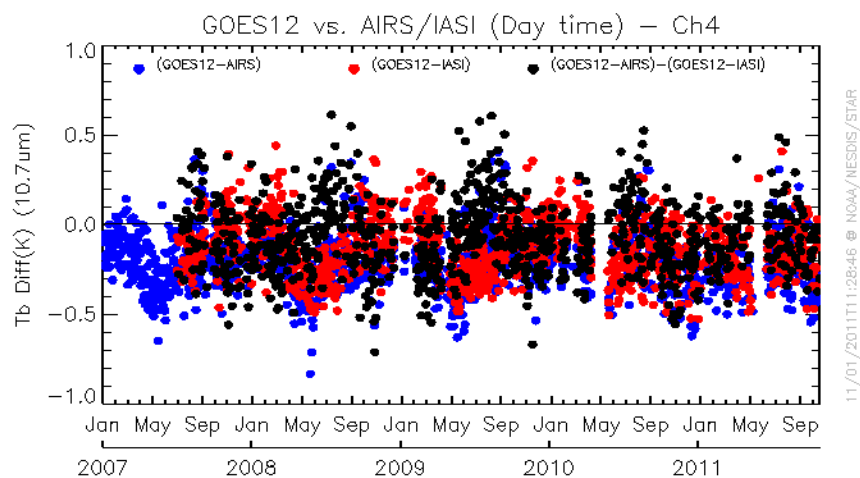
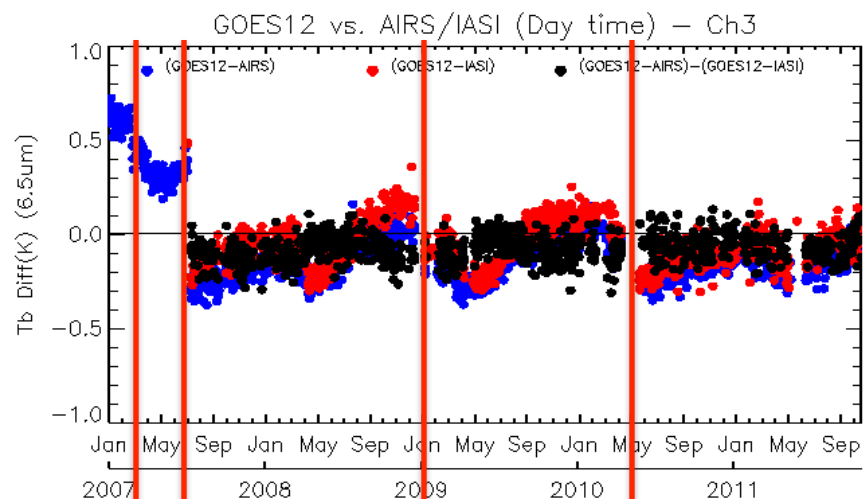
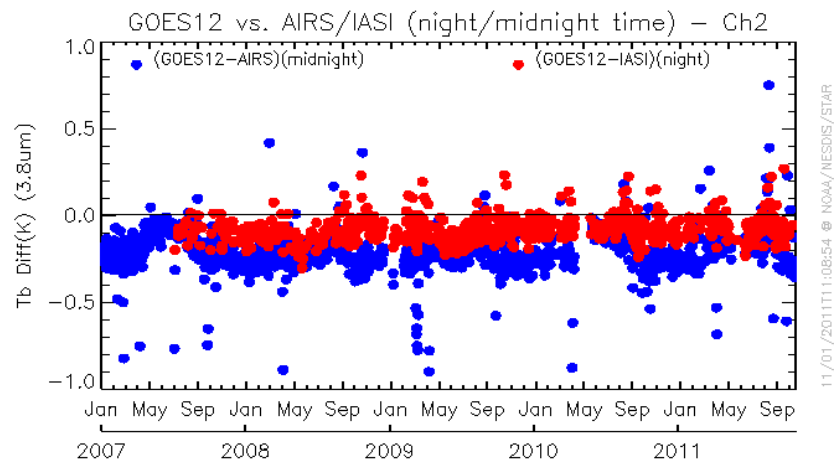


$$\text{mean}(\Delta T_{b_{\text{GEO-AIRS},j}}) - \text{mean}(\Delta T_{b_{\text{GEO-AIRS},j}})$$

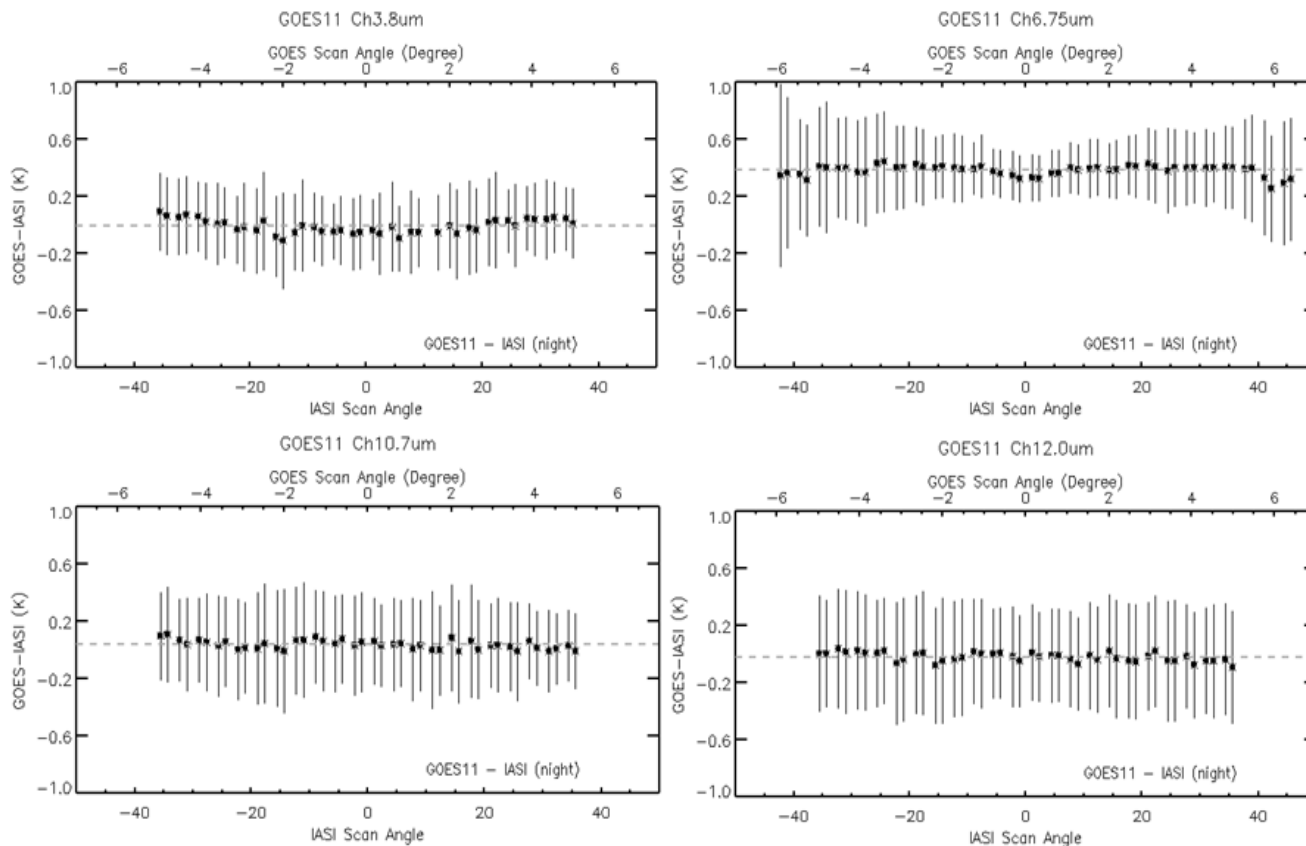
GOES-11 Imager Ch3/4/5 Diurnal Cal. Variation



GOES-12 Calibration Monitoring

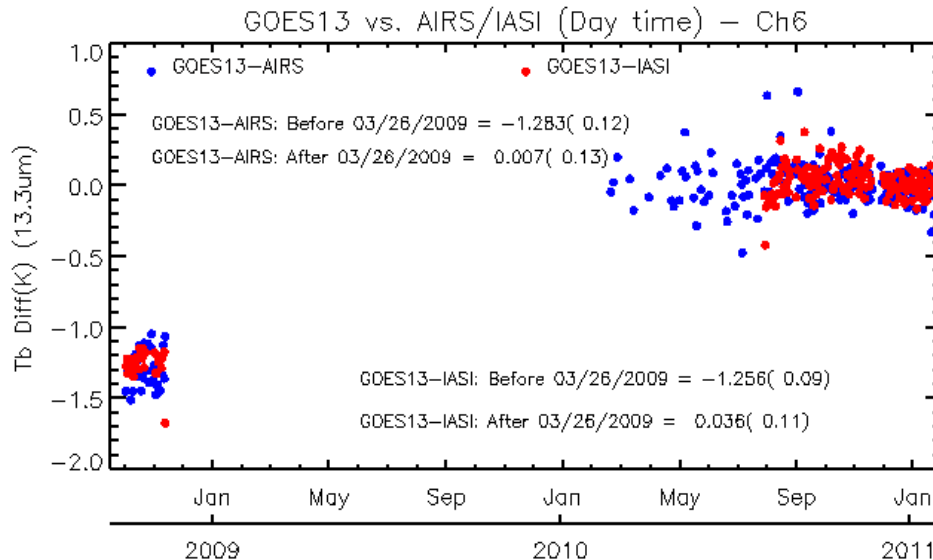
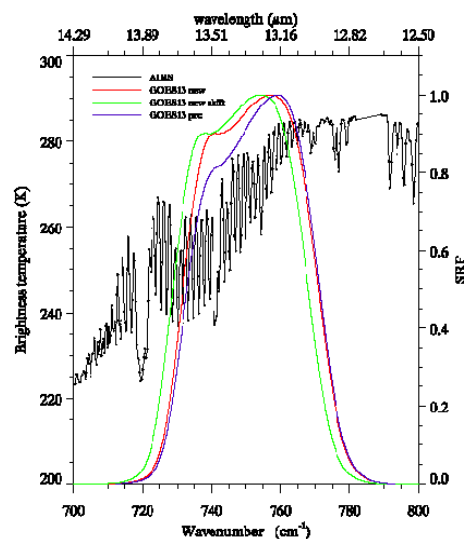


Evaluation of Angular Dependent Scan-Mirror Emissivity Correction



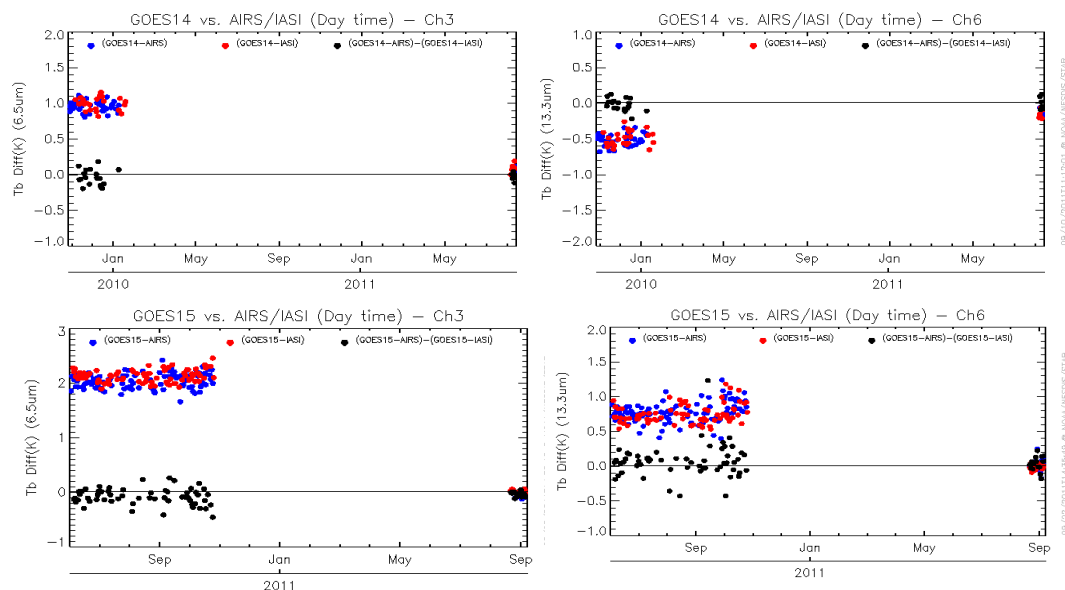
SRF Revision

- *ITT revised the G13 Ch6 (13.3m) SRF during the PLT period.*
- *NOAA shifted the SRF by -2.6 cm^{-1} with GOES vs AIRS collocated analysis data*



SRF Revisions for GOES14/15 Ch3 (6.5 μ m) and Ch6 (13.3 μ m)

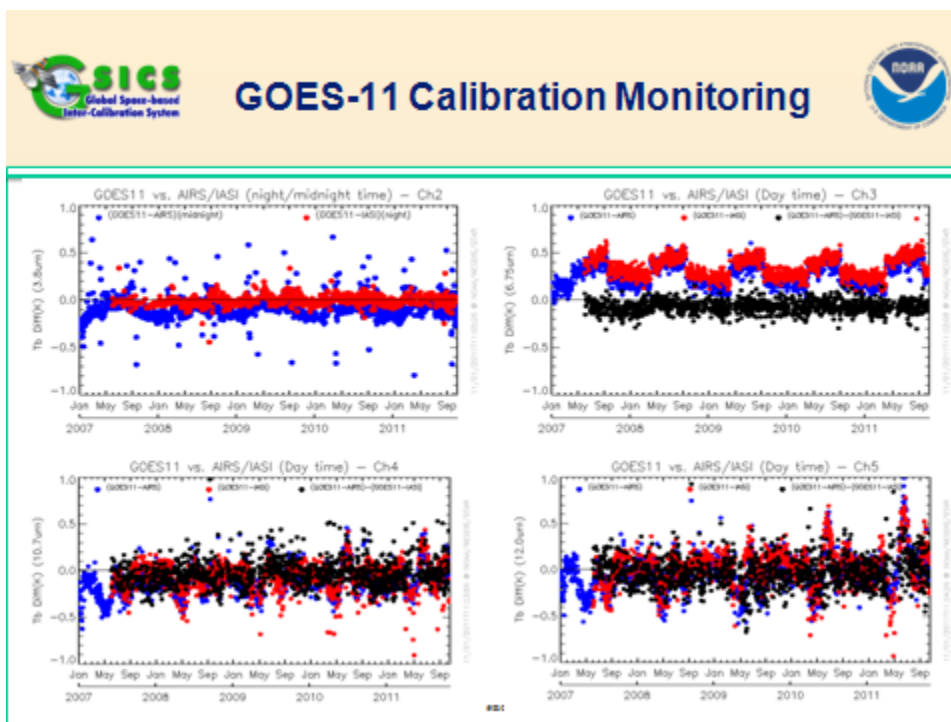
- *ITT revised the SRFs twice during the PLT period, but with still large simulated Tb biases*
- *NOAA shifted the SRFs using GOES vs. IASI analysis data*
- *New SRFs were implemented at the satellites on August 9, 2011.*



	Bias before revision		Bias after Revision	
	GOES - AIRS	GOES - IASI	GOES - AIRS	GOES - IASI
G14 Ch3	+0.99	+0.97	+0.07	+0.10
G14 Ch6	-0.48	-0.55	-0.11	-0.12
G15 Ch3	+2.04	+2.12	-0.04	+0.00
G15 Ch6	+0.77	+0.74	+0.01	-0.02

Summary

- *The well-calibrated hyperspectral sounding radiometers is very powerful in evaluating/monitoring/diagnosing the broad-band GOES IR calibration accuracy*
 - » Diurnal
 - » Seasonal
 - » Long-term
 - » Scan mirror emissivity correction
 - » MBCC performance
 - » Improve the radiometric calibration accuracy
- *As the reference instruments, the instruments should have stable calibration accuracy at corresponding terms*
- *The fundamental correction of the GOES midnight calibration anomaly using the GSICS data is undergoing...*



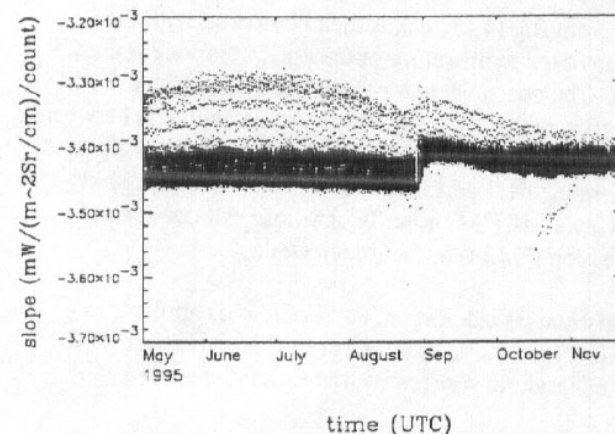
GOES Calibration Issues and Operational Remedies

- *Midnight Calibration Anomaly*

- » Causes:

- Extra radiation reflected by the BB to the detectors
- Scattered solar radiation contamination at space view

- » Remedy: Midnight Blackbody Calibration Correction (MBCC)



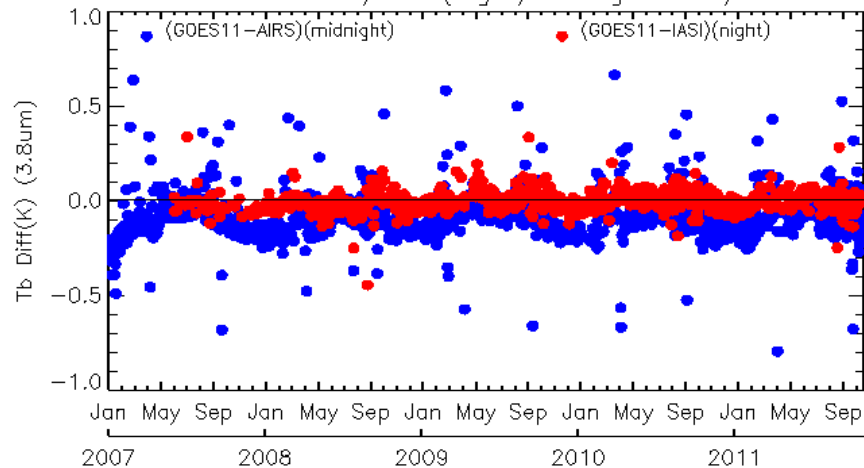
Original calibration slopes of GOES-8 Imager Ch2 (from Johnson et al. 1996)

- *Angular dependent scan-mirror emissivity*

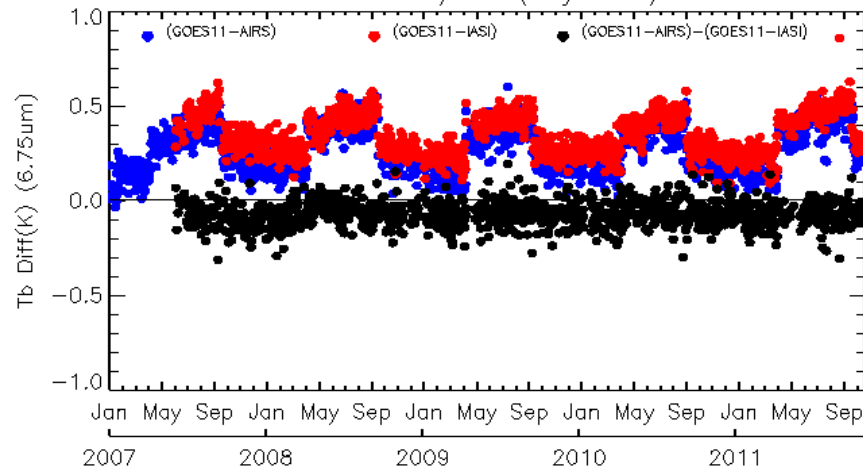
- » Absorptive feature of the Silicon dioxide (SiO_x) coating to the scan mirror
- » Remedy: corrected with a 24-h scan view scan.

GOES-11 Calibration Monitoring

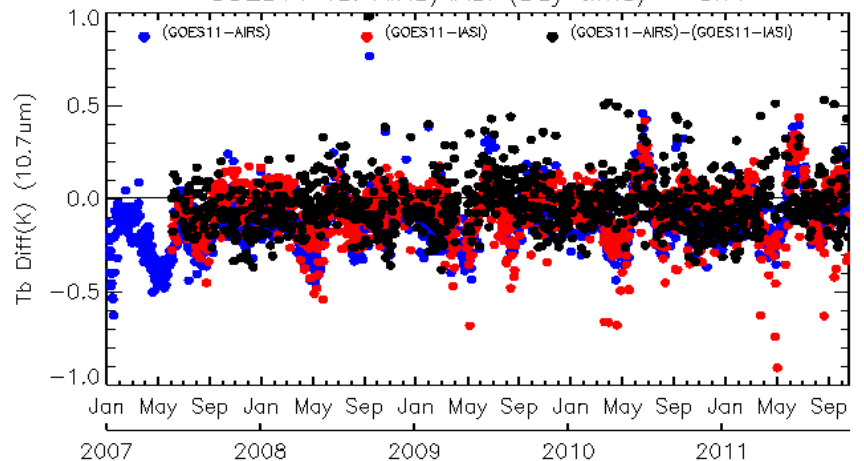
GOES11 vs. AIRS/IASI (night/midnight time) – Ch2



GOES11 vs. AIRS/IASI (Day time) – Ch3



GOES11 vs. AIRS/IASI (Day time) – Ch4



GOES11 vs. AIRS/IASI (Day time) – Ch5

